Nanoindentation for Intermetallics of Cu/Sn-3.5Ag Joints

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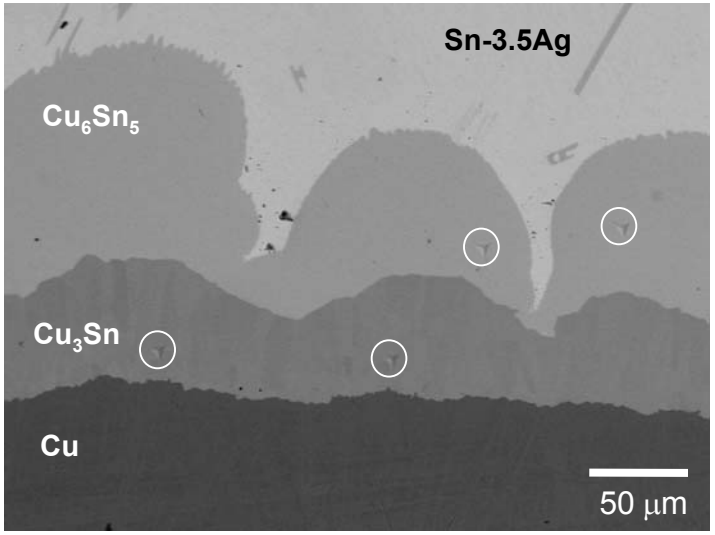
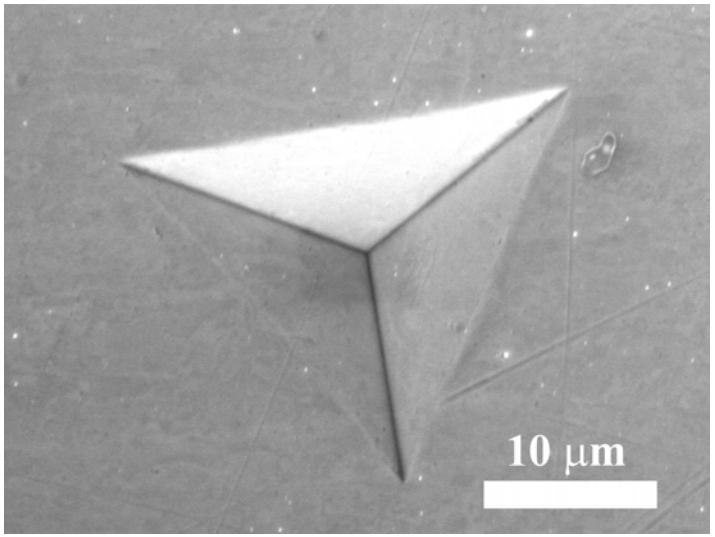
Nanoindentation is an effective test method for probing the elastic-plastic properties of intermetallics formed between Cu and Sn-3.5Ag solder. In our study, intermetallics were produced by reflowing solder on Cu substrate for long time. The elastic and plastic properties of the intermetallics were measured (Table 1).



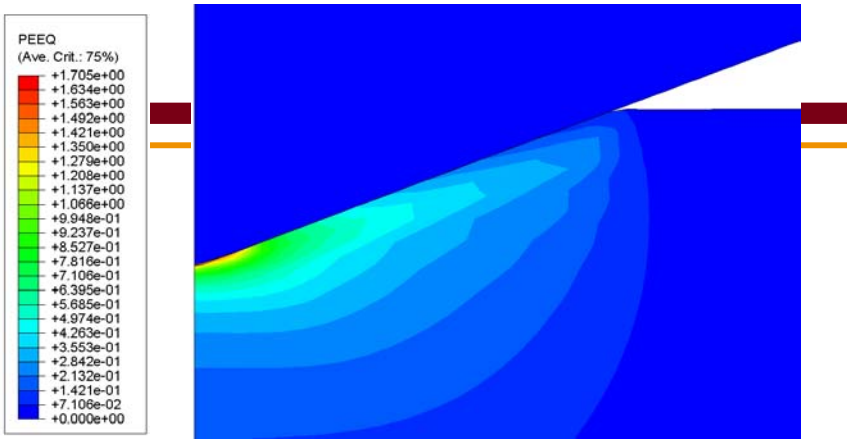
Intermetallics between solder and Cu substrate after long time reflow.

This study was critical because the elastic-plastic properties of intermetallics have not been measured in detail, and these properties are critical to understanding the mechanical behavior of Cu-solder joints.

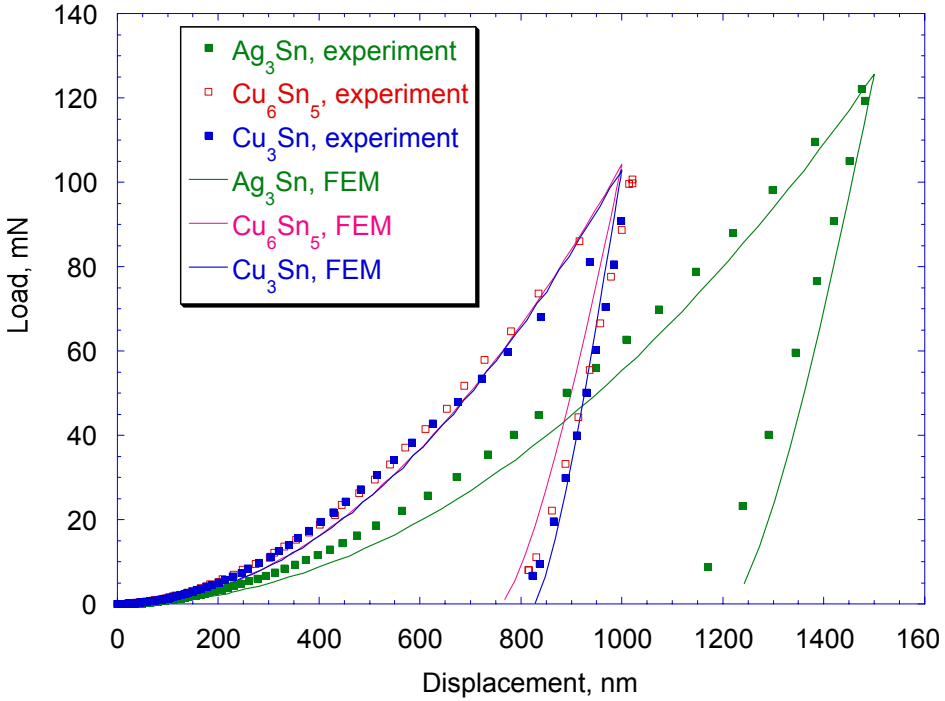
Finite element analysis simulation of nanoindentation shows excellent coorelation with the experimental data.



SEM of Indentation on Cu.



FEM Simulation of Equivalent Plastic Strain during Indentation



Comparison of nanoindentation experimental and simulated load-displacement curves, showing excellent agreement.

Table 1. Elastic-plastic properties of intermetallics, Cu, and solder

Phase	Young's Modulus, GPa	Yield Strength, MPa	Work Hardening Exponent
Cu	116.5 ± 4.7	174	0.1198
Solder	51.3 ± 4.5	37	0.0388
Ag_3Sn	78.9 ± 3.7	145	0.6243
Cu_6Sn_5	112.3 ± 5.0	774	0.4895
Cu_3Sn	134.2 ± 6.7	1039	0.2834